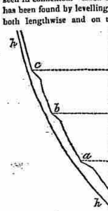
THE SCOTSMAN.

THE PARALLEL ROADS OF GLEN ROY.

THE problem respecting the origin of these Roads, which has so long perplexed *geologists*, has been at last solved, we think, by Mr Charles Darwin, the eminent naturalist who accompanied the late surveying expedition to the Southern Hemisphere. Mr Darwin's memoir was read before the Geological Society of London in February last, and has just been printed.

To some of our readers, it may be necessary to state what and where these Roads are. The deep natural cavity along which the Caledonian Canal passes, is called the Great Glen of Scotland. Several glens open into it, and among these is the glen through which the river Spean flows, ten miles northward of Fort William. Glen Roy is a lateral branch of Glen Spean, about eleven miles long, one mile broad, and pretty steep in the sides. The Spean falls into the river Lochy near Loch Lochy, and the Roy falls into the Spean five miles eastward. On both sides of Glen Roy, there *are three narrow terraces of gravel and clay*, called "the Parallel Roads." They project a few feet or yards from the sloping side of the mountain, forming three slightly marked lines along the valley from end to end, and exactly parallel to each other. At some parts they are entirely obliterated; for instance when they cross bare rock, where loose matter would not rest, and when the surface of the hill is gently inclined, because their slope there coincides with that of the alluvial cover. Very often their appearance is so faint, that a spectator may find himself standing on one without being aware of its existence; but at other parts they swell out into pretty broad terraces; and what seemed obscure to a spectator in juxtaposition with it, becomes more distinct when seen from the opposite side of the valley, where the eye takes in the line for a length of some miles, and the obscure parts and the well marked parts are seen in connexion. Each of these shelves or terraces has been found by levelling to be perfectly horizontal, both lengthwise and on the opposite sides of the valley. In the annexed figure, let *h h* represent a portion of the surface of the hill, consisting of rock, with a layer of clay and gravel resting upon it, as indicated by the uneven line. The Parallel Roads consist of thicker portions of this alluvial cover, projecting slightly like a shelf or terrace.



a, The *first* or lowest terrace, is 972 feet above the level of the sea.

b, The *second*, is 212 feet higher, or 1184 feet above the sea.

c, The *third*, is 182 feet higher than the second, or 1266 feet above the sea.

The shelves slope inward to the centre of the valley (to the line C B A), and are not quite so sharp and well defined as in the diagram.

In the adjoining valley of Glen Gloy, separated by an isthmus of high ground half a mile broad, there is a terrace twelve feet higher than *c*, or 1278 feet above the sea, but none lower. There is a remnant of a similar terrace at Kilfinnin, four miles northward, which is forty feet higher than *c*, or 1306 feet above the sea. The three terraces of Glen Roy follow the line of the valley down to its junction with Glen Spean, passing into all its sinuosities and recesses. Here two of them disappear; but the lowest continues its course up to the head of Glen Spean, and down nearly to its mouth, over a space of twenty miles, always preserving the same level. Lastly, portions of terraces have been discovered on the sides of the valley of the Spey, many miles eastward of those we have been describing, and at a computed elevation of 800 feet above the sea.

The notion once entertained, that these terraces were the remains of *roads* made by the Kings of Scotland for hunting (hence their name), is now too absurd for sober discussion. The Memoirs of Sir Thomas Dick Lauder and Dr Macculloch,* written nearly at the same time, prove that the terraces were formed by water. In lochs which have pretty steep banks, covered with materials somewhat loose, rains and storms hurry down earth and stones, which have their motion checked when they reach the water, and there form a projecting ledge or shelf, which is nearly on a level with its surface close to the shore, but slopes downwards as it advances, till it is some feet or yards below the water at its outer margin. Sir Thomas Dick Lauder observed shelves of this description under the water in Loch Lochy, Loch Oich, Loch Ness, and also in Linnhe Loch, which is an arm of the sea, and he inferred, that if by any accident one of these lochs were drained, the shelf round its margin would exactly represent one of the parallel roads of Glen Roy. The inference was established, and the principle beautifully illustrated, by a parallel case. At Subiaco in the Appen'nes, forty miles from Rome, there is a small valley, with a terrace of gravel and clay round its sides, similar to those of Glen Roy. The stream flowing through it escapes by a fissure in the rock at its lower end; but the Roman writers tell us that it was anciently a lake, and the fact is proved by the remains of baths yet standing, and precisely at the level of the terrace. Whether the fissure in the barrier, which is twelve or fifteen feet wide, was opened by an earthquake, or cut by the water, is not known.

Sir Thomas supposes that Glen Roy, Glen Gloy, and Glen Spean, formed distinct lochs, each being closed in by a barrier at its lower end. The barrier at the foot of Glen Roy had kept the water for a long period at the level of the dotted line *c* C, till the alluvium collected and formed the shelf *c*. The barrier was then partially removed or breached, and the waters subsided to the level *b* B, where they continued stationary till a new deposit of alluvium collected at the margin of the loch, and formed the shelf *b*. The barrier was again lowered or breached; the waters subsided to the level *a* A, where they remained stationary till the shelf *a* was formed. When this took place, the valleys of the Roy and the Spean formed one loch; for the shelf *a* passes from the Roy into the Spean on the same level, and extends along both sides of the latter for a space of 20 miles. On the other hand, no trace of the higher shelves *b* and *c* are found in the valley of the Spean. Sir Thomas therefore supposes, that when this lowest shelf *a* was formed, the two lochs were united, and shut in by a common barrier, which was below the junction of the valleys, about Highbridge, near the Great Glen. This barrier in its turn gave way, and the waters subsided gradually to their present level, leaving both valleys dry, and merely traversed by rivulets.

Glen Gloy in the same way formed a separate loch, shut in by a barrier near Loch Lochy, which held up the waters 12 feet above the greatest height of those in the Roy, till the shelf existing there was formed; after which the barrier opened, and the waters subsided till the valley became dry, without forming any other shelves.

Dr Macculloch's theory is similar to the above, but he assumes the existence of one or two barriers only, instead of three.

The insuperable objection to both theories is, that no trace of the barriers is visible. They must have consisted either of walls of solid rock, or mounds of clay and gravel, stretching across a valley one, two, or three miles wide; and whether we suppose that they were burst through at once from top to bottom, or worn down by successive stages, it is utterly inconceivable that every trace of such walls or mounds could have disappeared. If the nature of the process left this doubtful, the analogous cases of the lake of Subiaco, and of the Swiss lakes which have burst their barriers, would prove the fact. Neither can we assume that a transient deluge had swept away the remnants of the barriers; for a deluge sufficient to accomplish this would have obliterated every trace of the shelves. We see, besides, how the problem is complicated by the additional facts successively brought to light. Had the terraces been found only in Glen Roy, one barrier would have sufficed for the theory, and its existence, though no vestige of it remains, might have been admitted. But the terraces were found in Glen Spean, and another barrier must be imagined there, against all probability. They were found again in Glen Gloy, differing in level from those of the Roy, and thus a third imaginary barrier is rendered necessary. But the difficulties are not yet at an end. Mr Darwin finds terraces at Kilfinnin; of course a fourth barrier must be assumed here; and Sir David Brewster having found them in the valley of the Spey, a fifth is equally required. Now it is extremely improbable that even one of these barriers should have disappeared and left no wreck behind; but that all the five should have vanished, and not a vestige of any one of them remain, is utterly inconceivable.

Mr Darwin attributes the formation of the terraces to the sea, which at an early epoch filled these valleys, as it now fills the cavities forming Loch Eil, Loch Etive, Loch Long, &c. He thinks that the upheaval of the land, followed, of course, by the retreat of the waters, took place slowly and gradually as in Sweden at this day, not constantly and equably, however, *but with intermissions of rest, during which the terraces were formed*—that, in fact, these terraces belong to the earlier stages of that great series of movements by which the mainland of Scotland was raised above the water, and of which the last stage is so distinctly marked by the rise of thirty feet in the bed of the Forth, recently alluded to in this paper.

As geologists have long been aware that the highest mountains have at one time been covered by the sea, this explanation must have occurred to others, who were perhaps led to abandon it by two apparently formidable objections—first, the entire absence of marine remains from all the terraces; secondly, their local character, their want of continuity, and their non-existence in hundreds of other localities, where they should have been found, on the supposition that the cause which produced them was of so general and comprehensive a character. It would be too much to say that Mr Darwin has removed every difficulty which attends his hypothesis, but we think that his answer to the objections is upon the whole satisfactory.

The absence of marine remains is accounted for by the tendency of such animal substances to decay. On the coast of Forfarshire Mr Lyell found sea shells in gravel beds extending to the height of fifty or sixty feet, but in similar deposits of gravel, at greater altitudes, he found none, doubtless because the higher beds being first out of the water, and longest exposed, the organic remains in them had been decomposed. In Norway, near Christiania, there are stratified deposits of clay and sand ascending to the height of 600 feet above the sea; but shells are only found in those *patches which are under 200 feet*, and they are rare, and generally much decomposed, in those whose height exceeds 50 feet. The same acute observer found in a single deposit a most instructive example of the changes which these organic substances undergo, and thus describes it:—

"On the banks of a small river about two miles above Töusberg at the place where the bridge crosses it, a section of loamy clay is laid open, the lowest part of which cannot be raised more than a few feet above the salt water of the fiord of Christiania. In the upper part of the mass for a thickness of fifteen feet no fossils can be detected, but somewhat lower faint casts of the *Mytilus edulis*, chiefly indicated by purple stains, are observable. Still lower down more perfect specimens of the same shell, together with *Cardium edule*, occur, but both in so soft a state as to crumble into dust when dried. With these the more solid *Cyprina islandica* and *Saxicava rugosa* are occasionally found, and although soft when first taken from the matrix are capable when dried of being preserved entire. If in the short period which has probably passed away since these shells near Töusberg were imbedded, the progress of decay can have proceeded so far, we may well suppose the percolation of water during antecedent ages of indefinite extent to have destroyed all signs of fossils in the more ancient and elevated patches of loam found more than 500 feet high in the adjacent hilly country."

Mr Darwin, after citing these facts, adds—"In the *extensive* and *superficial* beds of elevated shells on the coast of Peru, where rain does not fall, and where consequently loose matter is not washed from the surface, I have traced, as I have ascended from the beach, a most perfect gradation in the decay of the shells, until a mere layer of calcareous powder without a vestige of structure alone remained."

Sweden is rising from the sea at the rate of 3 feet in a century. If we suppose the elevation of the soil of Scotland to have taken place at the same rate, the 900 feet of difference of level, between the Forfarshire beds which contain shells, and the lowest terrace in Glen Roy which contains none, will correspond to a period of 30,000 years; and from the facts just cited, we may safely infer, that a much shorter exposure would suffice to obliterate every trace of organic remains from the terraces, supposing that they originally existed there.

As to the second objection, the non-continuity or entire absence of the shelves, Mr Darwin's argument involves many details, and we can do little more than allude to it. He shows that a combination of circumstances, perhaps rarely occurring, was necessary to produce them. Among these are, a considerable inclination of the surface, the absence of bare rock, the existence of moveable debris above, the non-existence of strong currents. Add to this, that rains and storms must have had a considerable effect in obliterating the shelves; and that they must escape notice in many cases where they do exist, from the faintness of their appearance, and because they were not looked for. When Mr Darwin's speculations become known, we have no doubt that remains of terraces will be found in a hundred places where their existence has never been suspected. He accounts for the non-appearance in Glen Spean of the two upper terraces of Glen Roy, by observing, that when the water stood at the level of these terraces, Glen Spean would communicate with Glen Spey, and being then a channel connecting opposite seas, would be traversed by strong currents. He shows that a slight variation of circumstances makes any of the three terraces in Glen Roy disappear for a considerable space; that an intermediate terrace between *the second* and third *once* existed, of which only a small remnant is discoverable; that on the supposition of the waters receding slowly, an indefinite succession of little terraces would be formed, which would blend with the alluvial cover, and be undistinguishable from it, except at some parts where conditions very favourable to the generation of terraces existed; that the existence of a terrace in Glen Gloy twelve feet above the highest in Glen Roy, may be explained either in this way, or by the different height of the tides, as in the Strait of Magellan, where the tide rises twenty feet at one part, and forty at another some miles farther on. The sum of his argument is expressed in the general remark, that the obliteration of the terraces may be regarded as the natural and usual result—their preservation as an exception, arising from peculiar and favourable circumstances.

Erratic blocks belonging to distant localities are found both imbedded in, and resting on, the terraces. He supposes that masses of floating ice caught up these stones, and having stranded on the terraces, dropt them there. He found some at an elevation 1000 feet above the upper terrace in Glen Roy, showing that the water had once stood at that height. His remarks on the water-worn isthmuses connecting the valleys of the Roy, the Spey, and the Gloy, on the buttresses of gravel at the tributary streamlets, and on the deep alluvium in the bottom of these valleys, we have not room to speak of.

Mr Darwin's memoir connects together, and furnishes a key to a vast number of phenomena. In looking back to our own notes, taken on a visit to Glen Tilt in 1828, we find various facts which the principle he has evolved may serve to explain. We find, for instance, terraces of gravel marked as existing at the following localities: 1. In the open country between Perth and Dunkeld, 40 or 50 feet above the waters of the Tay; 2. At Logierait, a large table-shaped terrace, 60 or 70 feet above the flat land bordering the river, and probably 300 above the sea; 3. At Auld Clunie, above Killiecrankie, terraces at various heights—from 150 to 400 feet above the river, and probably from 400 to 700 above the sea; 4. In Glen Tilt, near Glen Criny, remnants of terraces ascending to the height of 100 or 150 feet above the stream, and 750 or 800 above the sea. On the top of these last, and on the south side of the stream, we found boulders of granite of one or two tons weight, belonging either to the rock on the opposite side of the deep ravine, or to some more distant locality. These alluvial terraces have generally deep cuts or gullies in them, displaying their structure and materials. Even the lowest ones, such as those between Perth and Dunkeld, can only be well accounted for by assuming, that the Tay formerly fell into a sea which stood forty or fifty feet higher than that which now receives its waters.

The perfect horizontality of the terraces of Glen Tilt and Glen Spean, prove that the levels were not sensibly disturbed over a space of 20 miles square, by the upheaving movement. Judging from the case of Sweden, we may even suppose that the rise was simultaneous, and nearly equable over all Scotland. We may hence infer, that when the upper terrace of Glen Roy was formed, Scotland consisted of an archipelago of islands, with one broad firth in the middle, and numerous narrow straits, canals, and inlets traversing its southern and northern divisions.

From articles of human workmanship embedded in alluvium with sea shells, it is found that Sweden has risen at least 60 feet, and Chile 85 feet, since these countries were inhabited by man. (Lyell's Elements of Geology, p. 296.)

An apology is due to our readers for the length and abstruse character of this article; but the subject has long excited a deep interest among scientific men, and we regard Mr Darwin's memoir as an important contribution to the physical history of Scotland.

* Transactions of Royal Society of Edinburgh, vol. ix., and of Geological Society of London, vol. iv., first series.

FOREIGN INTELLIGENCE.

HANOVER.

HANOVER, Aug. 22.—Both the second address of the city of *Hanover* to the German Diet and that of the provincial estates of Hadeln have been rejected. This event has caused a very great sensation here. The prospect of a termination of our differences by the highest authority is thus at an end. Will the committee of mediation give the country tranquillity and order? This is not the general opinion, and it is even probable that some members of the committee do not partake in it. The sittings have commenced, and it is said they were opened by his Majesty in person with a speech. A letter from Hanover of the 19th, inserted in the *Leipsic Gazette*, affirms, on the contrary, that the two documents in question have not been rejected. Another letter from Hanover, of the 22d, likewise says that news of the rejection of those two addresses by the Diet on the 13th of this month have been received, and likewise that the Diet would protect the constitution of 1819, as being avowedly in force, to prevent any further refusal to pay the taxes, and would reject as far as possible the application of single corporations, and intended thereby to deprive all unauthorized complaint of the means of exciting useless fermentation in the country.

LONDON, SATURDAY, AUGUST 31.

The Queen, accompanied by her Royal Highness the Duchess of Kent, his Serene Highness the Duke Ferdinand of Saxe Coburg, and her Serene Highness the Princess Victoire of Saxe Coburg, left Buckingham Palace for Windsor Castle, at five o'clock on Friday afternoon, in an open landau and four, with outriders in scarlet liveries. Her Majesty was escorted by a party of Light Dragoons.

Their Majesties, the King and Queen of the Belgians, are expected to arrive at Ramsgate about Tuesday next, from whence they will immediately proceed to Windsor, on a visit to her Majesty. Their Majesties will not return to the Continent until about the 24th of next month.

The Queen has been pleased to direct letters patent to be passed under the Great Seal of the United Kingdom of Great Britain and Ireland, constituting and appointing the Right Hon. Wm. Visct. Melbourne, the Rt. Hon. Francis T. Baring, Edw. Adolphus Seymour, Esq. (commonly called Lord Seymour), Robt. Steuart, Esq.; John Parker, Esq.; and Thos. Wyse, Esq., her Majesty's Commissioners for executing the offices of Treasurer of the Exchequer of Great Britain and Lord High Treasurer of Ireland.

The Queen was this day pleased to confer the honour of Knighthood upon John Gardner Wilkinson, Esq., Fellow of the Royal Society.

Her Majesty was also pleased to appoint the Right Hon. Richard Lalor Sheil Vice-President of the Board of Trade.

Her Majesty having been pleased to appoint the Right Hon. Charles Poulett Thompson Captain-General and Governor-in-Chief of the Canadas, the right hon. gentleman took the usual oaths appointed to be taken by the Governors of her Majesty's colonies.

Her Majesty in Council was pleased to appoint the Right Hon. Henry Labouchere President of the Committee of Council appointed for the consideration of all matters relating to Trade and Foreign Plantations.

The Right Hon. Francis Thornhill Baring, who has just been appointed Chancellor of the Exchequer, is the eldest son of Sir Thomas Baring, Bart., and nephew of Lord Ashburton. He married a niece of Earl Grey's. He has sat for the borough of Portsmouth since 1826. Mr Baring was a Lord of the Treasury from 1830, till June 1834, and then became one of the joint-secretaries of the Treasury, which office he has held ever since, except during Sir Robert Peel's short administration. He is full of financial knowledge, and is a man of great decision of character, with some degree of bluntness in his manners.

Mr Richard Lalor Sheil was, by command of the Queen, sworn of her Majesty's Most Honourable Privy-Council, and took his place at the Board.

The Honourable Captain Hay, brother to Lord Erroll, has been appointed sub-inspector of police in the county of Kilkenny, in the room of Captain Acklom, transferred to another county.

Viscount Melbourne left town on Friday evening for his residence, Brocket Hall, Herts.

Lord Morpeth left town on Thursday afternoon, for Castle Howard, Yorkshire, the seat of the Earl of Carlisle.

Mr Poulett Thompson will shortly leave town to assume the governorship of the Canadas.

THE MANCHESTER CHARTER.—The important and anxiously expected trial respecting the disputed coronership of Manchester, involving the validity of the charter of incorporation lately granted to Manchester, came on at Liverpool on Monday. After a lengthened investigation, a verdict was taken for the defendant, and in support of the charter, subject to a bill of exceptions, to be argued in the Exchequer Chamber, on some points raised by Mr Cresswell.

GREAT WESTERN RAILWAY.—The half-yearly general meeting of the proprietors of the Great Western Railway was held at the Merchants' Hall in Bristol on Wednesday. The meeting was very numerously attended. In the report the directors congratulated the proprietors on the present improved state of the works, and quoted from the accounts a detailed statement of the gross number of passengers, and also the average number *per diem* at various periods. The present average from London to Twyford is 1300 *per diem*, and the net profit, after deducting all charges for maintenance of way, salaries, &c., to the 30th of June last, was £36,766, 17s. 11d. Detailed statements of the present state and expected period of completion of the various remaining portions of the line were also given with great minuteness, the most prominent of which were that the line between Bristol and Bath would be opened early in the spring of the year 1840, to Reading in November next, and that the principal remaining difficulties would be the Box tunnel, and the cutting between Uffingham and Swindon. It was elicited that the total cost of the undertaking would be, including locomotive power and carriages, about £5,140,000; the total cost of land, £654,836; the cost of the permanent way per mile has been £6800; and the present cost of repairs, maintenance, &c., is about 57 per cent. on the cost; that is from London to Twyford. But the per centage will be much lower as the line is extended. The Chairman stated, that whereas the Great Western Railway had netted a profit of £36,700 to June last, the London and Birmingham was kept open at a considerable loss at first. The present rate of charge by the Great Western line, taking first and second class passengers, averages 2d. per mile; that of the London and Birmingham averages 2½d. per mile.